

ATLAS

Physics Division

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Outline

- **Physics goals**
- **Current responsibilities**
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- **Maintenance and Operations**
- **Upgrades**
- **US ATLAS Research Program**
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Physics Goals

- The rationale for studying TeV-scale collisions has been justified extensively over the last two decades and more.
- The LHC will get there first - discovery.
- Over the last some years, extensive simulation studies have been done by ATLAS and CMS.
- These studies have shown that precise measurements can also be done at high luminosity at the LHC.
- Having seen this development over the last 20 years, the strength of the physics justification for TeV-scale collisions, the LHC, has continued to increase.

Physics Potential - Summary*

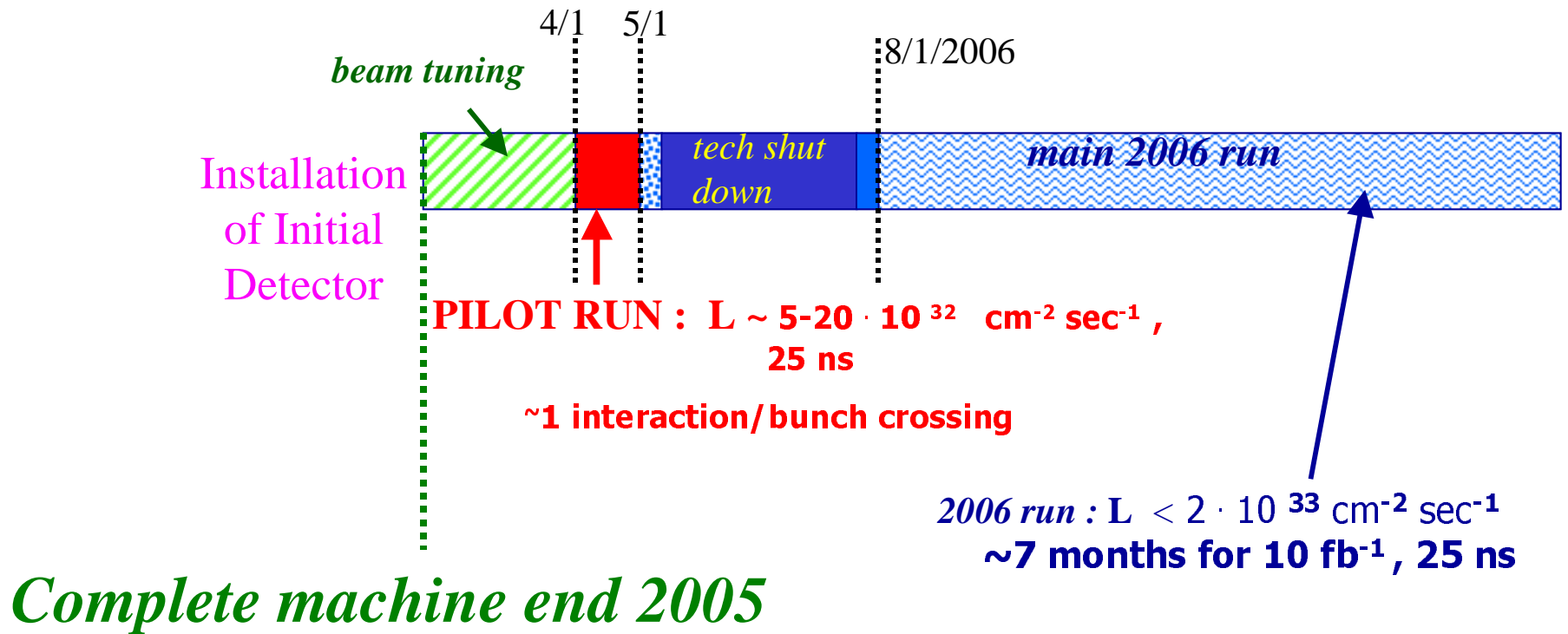
- If the minimal Standard Model is correct and the Higgs boson is not discovered previously, it will be found at the LHC.
- If supersymmetry is relevant to the breaking of electroweak symmetry, it will be discovered at LHC and many details of the particular supersymmetric model will be disentangled.
- If the Higgs sector is that of the minimal supersymmetric model, at least one Higgs decay channel will be seen, no matter what the parameters turn out to be. In many cases, several Higgs bosons or decay channels will be seen.
- If the electroweak symmetry breaking proceeds via some new strong interactions, many resonances and new exotic particles will almost certainly be observed.
- New gauge bosons with masses less than several TeV will be discovered or ruled out.
- Signals for extra-dimensions will be revealed if the relevant scale is in the TeV range.

* Taken directly from summary of ATLAS and CMS physics studies, prepared largely by Ian Hinchliffe.

Current Responsibilities

- **Pixel tracking detector**
 - ◆ Large roles in mechanics, electronics, module assembly/test
 - ◆ Fabricate and deliver end sections of detector and global supporting structure, including part holding interaction region beam pipe.
 - ◆ Production of some aspects(mechanics) starting middle of this year and continues until end of 2004. Installation follows.
- **Silicon Strip Tracker**
 - ◆ Integrated circuit test system, production testing by end this year(using our system at Santa Cruz, RAL, CERN)
 - ◆ Module assembly/test, production starts early next year and continues until end 2003.
- **Software/Physics Simulation**
 - ◆ Lead role in “framework” software(ATHENA).
 - ◆ Major role in physics simulation software and use. First mock data challenge next year.
 - ◆ Software work will continue past 1st collisions.

LHC Schedule



PIXELS

PIXELS

STRIPS

LBNL Deliverables

SOFTWARE

Maintenance and Operations

- ATLAS is expecting to begin the maintenance and operations(M&O) phase of the experiment well before 1st collisions and would like this to begin now to solve funding problems.
- Formal interactions between CERN and the 30-some collaborating funding agencies on M&O are underway.
- The LHC experimental program is much too large for CERN to support in the LEP fashion as the host laboratory => substantial finances and manpower from outside CERN will be required.
- This is new territory, both practically and politically, and there is considerable uncertainty about how to proceed => progress is slow.

Upgrades

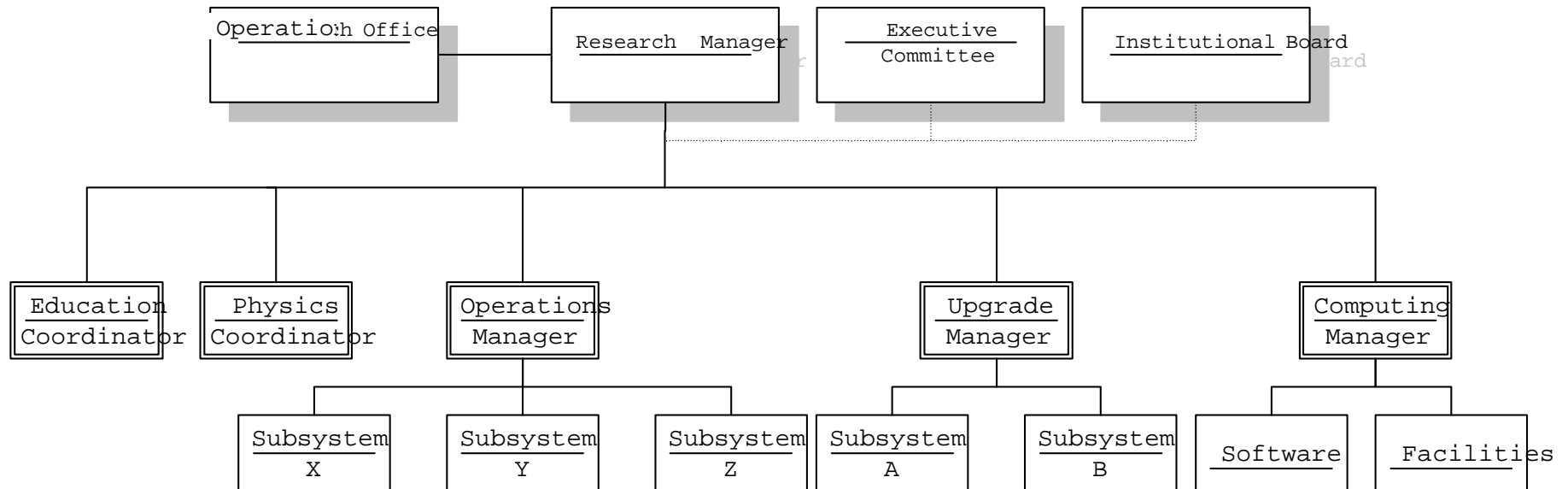
- **Part I - complete the detector(2006/7) + R&D**
 - ◆ Current world-wide funding is not sufficient to complete all of ATLAS(or CMS) by the end of 2005. CERN interacting with funding agencies on solution.
 - ◆ In the US(perhaps elsewhere), completion will likely fall into the “upgrade” category and hopefully funding will start before 1st collisions, during first installation.
 - ◆ Among the items likely in this category is the pixel detector => continuing LBNL responsibility.
 - ◆ In addition, upgrade R&D will be required for Part II.
- **Part II - after first run(s)(2008 ->2012)**
 - ◆ Fix problems not foreseen. Continue R&D.
 - ◆ Replace with better technology(pixel B-Layer, trigger,...).
- **Part III - major upgrades, luminosity upgrade(2012 -> ?)**
 - ◆ New detector ideas even if luminosity still around 10^{34}
 - ◆ Physics potential for $L > 10^{34}$ to be formally documented by Sept. 2001 for inclusion in CERN “25 year plan”. Preliminary study done.

US ATLAS Research Program

- BNL has been formally charged by the DoE and NSF with managing the US Research Program phase of ATLAS(FNAL has this responsibility for CMS).
- The US ATLAS Research Program includes
 - ◆ maintenance and operations
 - ◆ software and computing
 - ◆ at least some aspects of upgrade R&D
 - ◆ upgrades(as they become formal projects)
 - ◆ facilitation of physics analysis.
- Current US ATLAS management plans for physicists(including postdocs) to be supported via the “traditional” base program - not projectized(funding controlled by US ATLAS management).
- A US ATLAS Research Program management plan, including preliminary budgets, is under preparation - see organization chart next page.
- First funding will be requested for FY03.

US ATLAS Research Organization

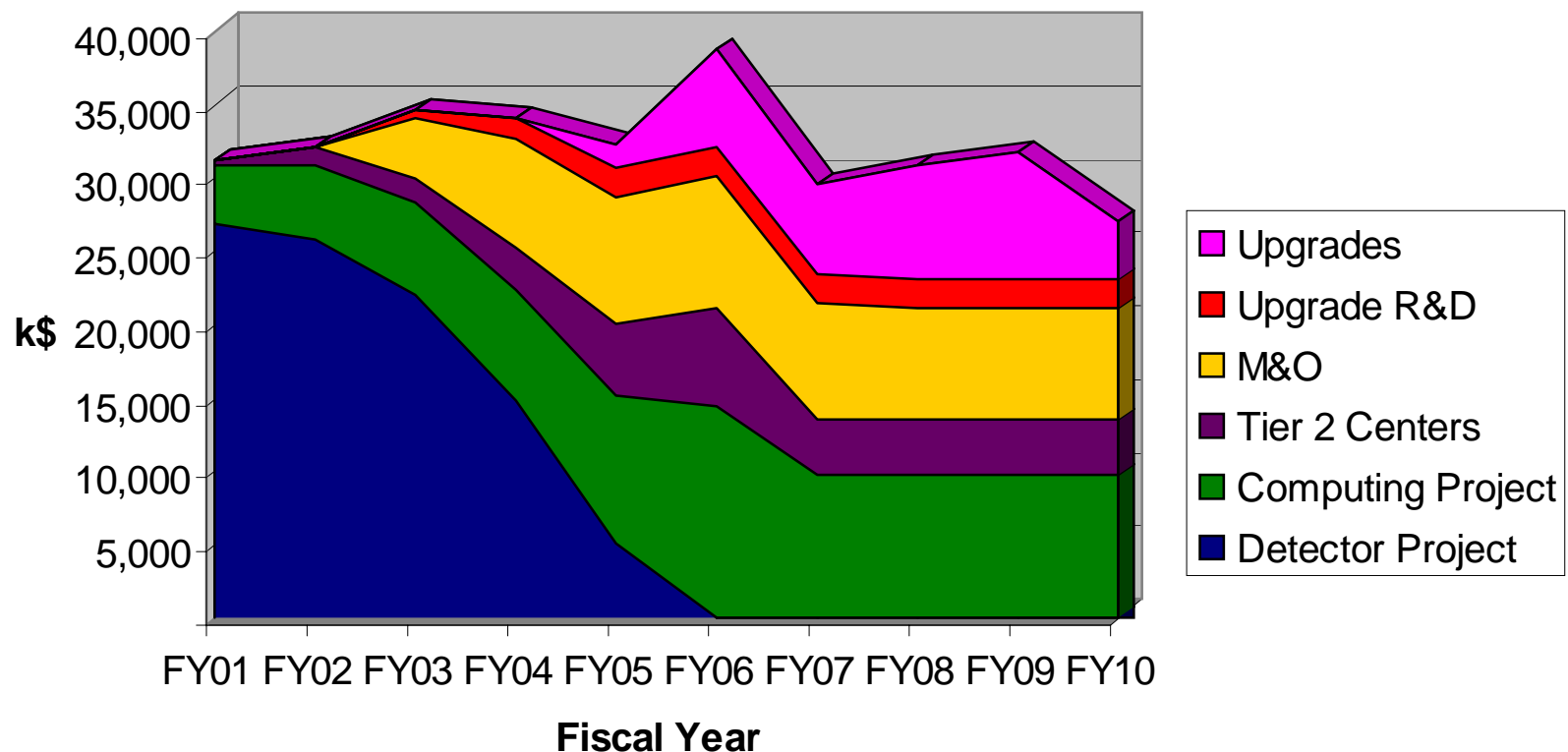
U.S. ATLAS Research Organization



Virtual US laboratory with Research Manager as “Lab Director”

US ATLAS Research Program Funding

Preliminary estimate - does not include funding for physicists



Timeline for LBNL

- **Now to 2006(1st collisions)**
 - ◆ Complete our “hardware” project responsibilities for initial detector.
 - ◆ Complete our software responsibilities
 - ◆ Prepare for data analysis - physics
 - ◆ Begin maintenance and operation responsibilities
 - ◆ Part I upgrades to complete detector
- **From 2006 -> 2012**
 - ◆ Physics analysis
 - ◆ Maintain and operate detector(including software)
 - ◆ Complete Part I upgrades(pixels + software)
 - ◆ Upgrade R&D
 - ◆ Part II upgrades.

Implications for LBNL(1)

- **Senior personnel**

- ◆ Level of senior personnel has declined since we joined ATLAS. Need more, open invitation to join ATLAS group.
- ◆ Need to add some more youthful energy. Junior faculty /Divisional Fellow(s) starting in 2003. Surely more than one.
- ◆ During installation, commissioning, operation, there will have to be senior LBNL personnel at CERN for extended periods.
- ◆ In my opinion, the operational mode LBNL has used for CDF, BaBar, D0...will not work for ATLAS. ATLAS much larger, US organization more formal and can't commute to CERN.

- **Postdocs**

- ◆ Currently 2.5, the 0.5 being person in transition to CDF.
- ◆ Number must grow to complete hardware and software responsibilities before 2006, prepare and do physics analysis, meet operations responsibilities and take part in upgrades and related R&D.

Implications for LBNL(2)

- **Technical Staff - Hardware**

- ◆ Very strong team has been assembled for ATLAS, building on developments, particularly electronics and “silicon”, done for CDF, D0 and BaBar.
- ◆ The critical capabilities reside in both in the Engineering Division and Physics Division. Will continue to need both.
- ◆ Some fraction of this team must continue into operations phase. Both electrical and mechanical capabilities needed.
- ◆ If we want to continue in ATLAS upgrades, we must also maintain the core of these technical capabilities.

Implications for LBNL(3)

- **Technical staff - software and computing**
 - ◆ Professional software engineering will be needed for lifetime of experiment. NERSC personnel currently supported by ATLAS, not base program.
 - ◆ Operations, upgrades...for software also.
 - ◆ Amount will vary with time, but just as in the hardware side, need to retain core of capability.
 - ◆ Again this is divided between Phys. Div and NERSC, but mostly in NERSC.
- **Infrastructure**
 - ◆ Improvements to hardware infrastructure have come largely from Project funds or through Engineering Division.
 - ◆ Connection to Engineering Division staff critical to continue hardware infrastructure improvements.
 - ◆ Local computing infrastructure to do physics analysis not yet really addressed by us(this is OK until next year).
 - ◆ LBL as Tier 2 computing site(maybe “regional center”) desired but not yet funded.

Implications for LBNL(4)

- We will be very busy in 2004-2008!
 - ◆ Complete pixel construction
 - ◆ Install initial pixel system
 - ◆ Commission silicon strips and pixels
 - ◆ Complete framework and related software
 - ◆ Mock data challenge, data analysis
 - ◆ Maintenance and operation of strips, pixels and software
 - ◆ Part I upgrade(pixel detector completion)
 - ◆ Upgrade R&D
- ATLAS + CMS are projected to be about 1/2 of the US DoE/NSF experimental HEP program by 2006/2007 as determined by number of collaboration members.
- Simple scaling implies that ATLAS physicists should be $\geq 25\%$ of the DoE-supported experimental part of the Division.
Extrapolating LBNL role to 2004-2008 => larger than average fraction, consistent with “laboratory” role.

Implications - Bottom Line

- Get more senior people on ATLAS. Open invitation.
- Start adding Assist. Prof/Div. Fellow(s) in 2003.
- Ramp up number of postdocs to about 10 by 2006/7.
- Maintain hardware and software technical core
 - ◆ New mode of operations support will require long-term technical personnel from LBNL, both hardware(electrical and mechanical) and software.
 - ◆ Develop and work on upgrades(hardware and software).
 - ◆ Synergy with other projects/programs but also R&D, including outside HEP, to maintain technical personnel.
 - ◆ Maintain capability within Phys. Division to innovate and lead in technical areas.
- But must put physics analysis first!

Funding Sources for ATLAS

- **Current financial support**
 - ♦ DoE base program
 - ♦ DoE construction project
 - ♦ DoE and NSF support of computing
 - ♦ Infrastructure support(primarily via Eng. Div)
- In the past we have been fortunate to receive LDRD support, and indirect support via DoE SBIR and other one-shot programs.
- **Sources of future financial support**
 - ♦ DoE base program
 - ♦ DoE construction project - until completed by end FY05.
 - ♦ DoE and NSF support of computing, until absorbed into US Research Program(by FY03?)
 - ♦ Infrastructure support(primarily via Eng. Div)
 - ♦ US Research Program funding, hopefully FY03 -> ?
 - ♦ Maybe LDRD or similar, if new R&D is sufficiently compelling.
- There is practically no hope of obtaining funding outside these traditional sources.

Conclusions

- Fantastic physics potential.
- LBNL has worked for this for about two decades already.
- Finish and operate ATLAS.
- Do physics.
- Improve ATLAS and do more physics.
- Doing ATLAS right will be a critical test of LBNL's viability in HEP as a national laboratory over the next decade.